

**WHAT IS CLAIMED IS:**

- 1        1.     A process comprising:
  - 2            a)     exposing a chemical species to nanoparticles such that said chemical
  - 3                species adsorbs onto a surface of the nanoparticles as a chemical
  - 4                adsorbate;
  - 5            b)     irradiating the nanoparticles comprising the chemical adsorbate with
  - 6                radiation;
  - 7            c)     detecting altered photoluminescence properties of the nanoparticles
  - 8                comprising the chemical adsorbate; and
  - 9            d)     analyzing the altered photoluminescence properties by comparing to
  - 10                one or more pre-defined altered photoluminescence properties, to
  - 11                provide for an identifying of the chemical species.
- 1        2.     The process of claim 1, wherein the radiation comprises ultraviolet radiation.
- 1        3.     The process of claim 1, wherein the nanoparticles comprise quantum
- 2        confined nanoparticles.
- 1        4.     The process of claim 1, wherein the nanoparticles comprise silicon
- 2        nanoparticles.
- 1        5.     The process of claim 1, wherein the one or more pre-defined altered
- 2        photoluminescence properties are provided by exposing nanoparticles having initial
- 3        photoluminescence properties to one or more known chemical species.
- 1        6.     The process of claim 1, wherein the chemical species is selected from the
- 2        group consisting of toxins, carcinogens, mutagens, lachrymators, flammable species, nerve
- 3        agents, explosives, and combinations thereof.

1           7. The process of claim 1, wherein the adsorption of a chemical species onto the  
2 surface of the nanoparticles comprises a reversible process.

1           8. The process of claim 1, wherein the nanoparticles range in size from about 1  
2 nm to about 100 nm.

1           9. The process of claim 1, wherein the nanoparticles are present in an aerosol.

1           10. The process of claim 1, wherein the detecting the altered photoluminescence  
2 properties comprises utilizing a wavelength selective detector.

1           11. The process of claim 1, wherein the analyzing the altered photoluminescence  
2 properties comprises utilizing a wavelength selective detector.

1           12. The process of claim 1, wherein the detecting and analyzing the altered  
2 photoluminescence properties comprises utilizing a spectrometer.

1           13. The process of claim 1, wherein the detecting and analyzing the altered  
2 photoluminescence properties comprises utilizing an optical filter.

1           14. The process of claim 1, wherein the nanoparticles are silicon nanocrystals.

1           15. The process of claim 1, further comprising determining a concentration of the  
2 chemical species.

1           16. A process comprising using nanoparticles as taggants for material  
2 identification.

1           17. The process of claim 16, wherein the material is selected from the group  
2 consisting of toxins, carcinogens, mutagens, lachrymators, flammable species, nerve agents,  
3 explosives, and combinations thereof.

1           18. The process of claim 16, wherein the taggants are used in anti-counterfeiting  
2 applications.

1           19. The process of claim 16, wherein the identification is based on properties  
2 unique to the nanoparticles.

1           20. The process of claim 19, wherein a unique property is photoluminescence.